

## CHAPTER 3

### COMMUNICATIONS CENTER

#### 3.1 GENERAL

The communications center is the circuit control routing and message processing portion of the Naval Communications station. The physical areas of the communications center are those required for the introduction, processing, and receipt of communications traffic into and from the communications system. Figure 3-1 shows the division of a communications center into functional areas and indicates the flow of communications within the center. The various equipments are physically grouped in conformance with this functional concept.

#### 3.2 TECHNICAL CONTROL

MIL-STD-188-310, Subsystem Design and Engineering Standards for Technical Control Facilities, is the governing document for the design of technical control facilities of DCS stations.

Technical control of the quality of all circuits is exercised in the technical control facility (TCF); however technical control functions are performed in three distinct areas:

Technical Control Facility (Supervisory area)  
Communications Security Equipment (CSE) area (Patch and Test, CRYPTO)  
Telegraph (TLG) Terminal/Modem Equipment area (Patch and Test, TLG Terminals/Modems)

Technical control actions are performed by using patch and test facilities that allow technical control personnel to monitor and substitute equipment. Although patch and test facilities are included in all three areas, the overall technical control function is managed from the TCF where all circuit operational patching is done.

The definitions applicable to these functional areas are given in the following paragraphs.

##### 3.2.1 Technical Control Facility (TCF)

The TCF area is the area in which there is installed circuit and channel patchboards, test equipment and monitoring facilities sufficient to permit a technical controller to:

- a. Exercise technical coordination between the connecting external technical control(s), the maintenance element and the users.
- b. Exercise technical direction, coordination and supervision over (1) transmission media at the super group, group and channel level, (2) interface equipment appearing in the patch and test facilities, (3) remote transmitter and receiver sites, (4) relay sites, and (5) those communications facilities at all directly connected user installations.

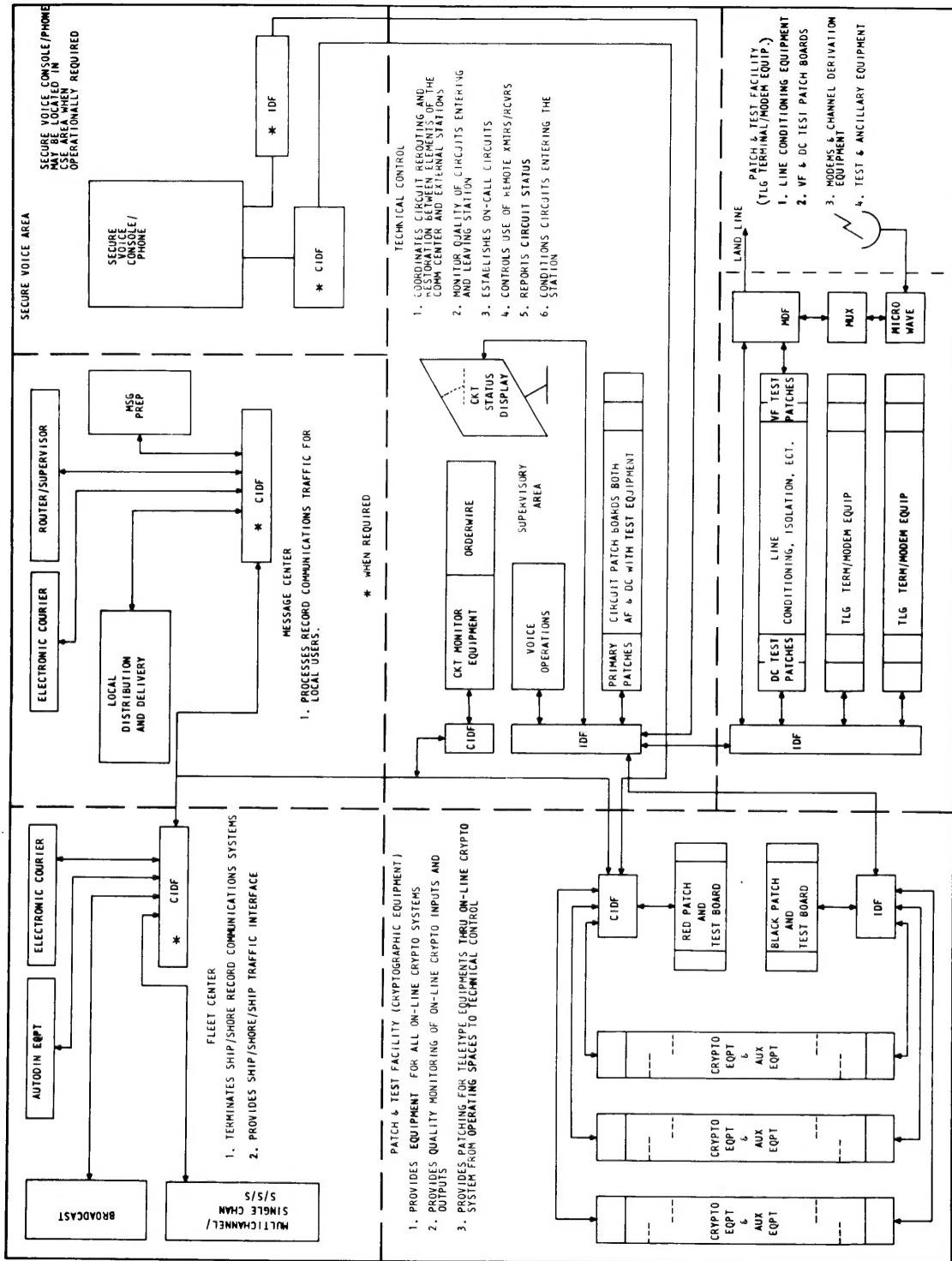


Figure 3-1. Functional Division Concept for Communication Center

- c. Reroute and restore disrupted communications circuits at all levels of circuit capability in accordance with a pre-determined priority.
- d. Establish on-call circuits.
- e. Perform quality control tests on all circuits passing through the TCF.
- f. Establish, activate or deactivate, rearrange, and discontinue circuits that enter and leave the station.
- g. Report circuit status to proper management for record purposes.

### **3.2.2 Patch & Test Facility (CSE) Area.**

The CSE area is the area that contains on-line cryptographic and associated ancillary equipments with sufficient patchboard, test and monitoring equipment to permit personnel to:

- a. Isolate equipment troubles occurring in the CSE area.
- b. Substitute equipments, channels and circuits within the CSE area.
- c. Perform back-to-back and loop-patching of cryptographic equipments, channels and circuits for maintenance testing.
- d. Perform monitoring and testing.
- e. Perform crypto start and restart.

### **3.2.3 Patch & Test Facility (TLG) Terminal/Modem Equipment Area**

The TLG terminal equipment area is the area containing line conditioning equipment, modems and modem channel derivation equipment, VF and DC test boards to permit personnel to:

- a. Condition all lines to meet transmission criteria.
- b. Restore (repair) disrupted communications links.
- c. Replace and/or by-pass faulty equipment.

All equipment in this area shall be extended through either VF or DC test patch facilities in this area, or both in the case of telegraph terminal/modem equipment, to facilitate maintenance of equipment.

### **3.2.4 Technical Control Task Breakdown.**

The breakdown of tasks within the three functional areas defined above is as follows:

- a. Technical Control Facility (Supervisory Area). This area is operated as a limited access area with the capability of being temporarily unclassified with a minimum of effort in the event that personnel with a lesser clearance require access for maintenance or installation. Facilities included are:

- (1) Covered data orderwires
- (2) Limited classified circuit monitoring and testing can be provided on a patch basis by the Patch and Test Facility (CSE).
- (3) Circuit status display
- (4) Unclassified Voice Control
- (5) Transmitter, receiver and intra-station link control
- (6) Equal level and primary VF and DC patchboards
- (7) Digital and Analog testing facilities
- (8) Supervisory alarm control display center
- (9) Supervisory control equipment for control of patch and test facilities
- (10) DCS reporting capability
- (11) Intra-Station Voice Orderwires

b. Patch and Test Facility (CSE) Area - This is an exclusion area. Facilities included are:

- (1) Black patchboards and test facilities to enable the back-to-back patching of crypto security equipment for maintenance.
- (2) On-line crypto security equipment with associated ancillary units less remote control units normally associated with an operating position.
- (3) Red patchboards separated from the black boards physically and electrically to prevent interconnection by patching, electrical induction or accidental interconnections.
- (4) The required test equipment for the adequate maintenance and repair of low level devices, cryptographic equipment and the lines to the red processing equipment.
- (5) Classified and unclassified digital test equipment.
- (6) Narrative TTY monitors.

c. Patch and Test Facility (TLG Terminal/Modem Equipment) Area.

- (1) All TLG terminal/modem and ancillary equipment
- (2) VF and DC test boards
- (3) All line conditioning equipment
- (4) Other (ancillary) equipment and test equipment

### 3.3 PATCH AND TEST FACILITIES

Appendix E of MIL-STD-188-310 will be the governing document for Patch and Test Facilities of DCS stations.

Patch and test facilities are located in each of the above technical control areas to provide operational flexibility in the use of equipment and circuits. In general, these patch and test facilities allow equipment and circuit changes under the direction of the technical control supervisor as follows:

- a. Patching of any circuit to any other compatible circuit
- b. Patching of equipment to replace faulty equipment
- c. Patching of test equipment to determine signal quality or circuit degradation

Figure 3-2 shows a typical circuit flow as it would be engineered through the patch and test facilities of the three technical control areas. The standard plans (see Chapter 2) provide the specific routing criteria for each type of circuit as it is distributed through the communications center. The standard SB-3092 ( ) audio patch is used for VF test, primary and equal level functions. The standard SB-3189 ( ) DC patch is used for DC test and channel control functions.

## LEGEND:

IDF = INTERMEDIATE DISTRIBUTION FRAME  
 MDF = MAIN DISTRIBUTION FRAME  
 CIDF = CLASSIFIED INTERMEDIATE DISTRIBUTION FRAME  
 P&TF = PATCH AND TEST FACILITY  
 (CSE) = COMMUNICATION SECURITY EQUIPMENT AREA  
 TCF = TECHNICAL CONTROL FACILITY  
 SUPVR = SUPERVISOR  
 TLG = TELEGRAPH

\*THESE PATCHES USED ONLY WHERE EQUIPMENTS DO NOT CONTAIN INPUT/OUTPUT TEST POINTS OR INTEGRAL PATCHING.

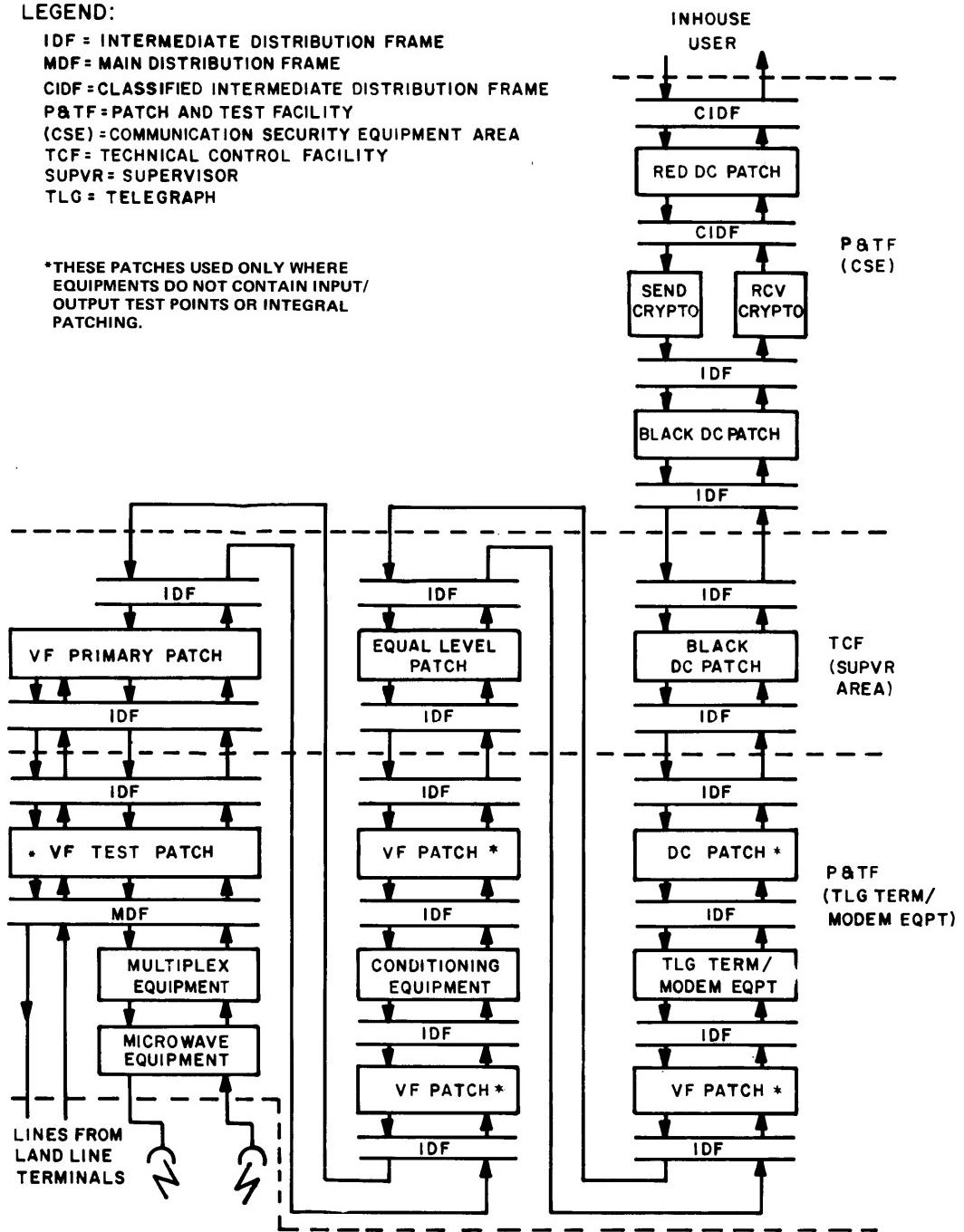


Figure 3-2. Typical Circuit Flow Through Communications Center Patching Facilities

### 3.4 PATCHBOARD EQUIPMENT

The patchboard equipment gives technical control personnel the flexibility to substitute and reconfigure the communications resources and they afford access for monitoring circuit quality. The patchboards are wired to attain the circuit flow prescribed by the NAVELEX standard plan for the system being implemented. The wiring criteria for these patchboards are described in Chapter 9. In a patchboard each circuit appears at a jack which permits rerouting of the circuit through the use of patch cords. However, the design of the circuit requires that all jacks be the "normal through" type, so that patch cords are not required when the circuit is operating normally. There are three basic types of patch modules used within the Communications Center:

- a. Audio Patch Module, SB-3092A/U, NAVELEX Standard Plan 0100405
- b. DC Patch Module, SB-3189A and B/FGC, NAVELEX Standard Plan 0100449 for large stations and 0100448 for small stations (10 modules or less).
- c. General Purpose Multi-circuit Patch Module, NAVELEX Standard Plan 0100305.

The audio and DC patch modules, except the multi-circuit modules contain groups of jacks for 26 circuits each. Patch modules may be added as necessary to meet the current and future circuit requirements.

The assignment of circuits and equipments to specific jacks in a patchboard is accomplished by cross-connections at the distribution frame. All circuits that are accommodated by a particular patch module are arranged in an order that closely fits the function for which the module is used. This arrangement permits quick location of a specific circuit or item of equipment for monitoring or troubleshooting.

Separate patchboards are provided for Red and Black information and these are separated by a minimum of 3 feet. MIL-STD-188-310, and Appendix A thereto, define patching logic and configurations requirements for future DCS stations.

#### 3.4.1 DC Patchboards Terminating Telegraph Terminal Equipment

Voice-frequency carrier telegraph (VFCT) DC circuits are assigned to patchboards with the jack field arranged as shown in figure 3-3. A 104-circuit-capability is the maximum for a single equipment cabinet. When additional circuits are required, other equipment cabinets with patchboards are used and the system grouping is continued. DC patchboards are made up of the standard SB-3189 patch modules which are provided only as needed to satisfy the circuit requirements.

#### 3.4.2 Red DC Patch Modules Terminating Hubber Units

The numerous inputs and outputs of the hubber unit and its broad range of capabilities dictate the representative arrangement of jacks illustrated by figure 3-4. In this configuration each module of the hubber unit requires four sets of jacks, and these sets appear on the patchboard consecutively from left to right. The SB-3189 ( ) DC Patch Module is used to terminate hubbing units.

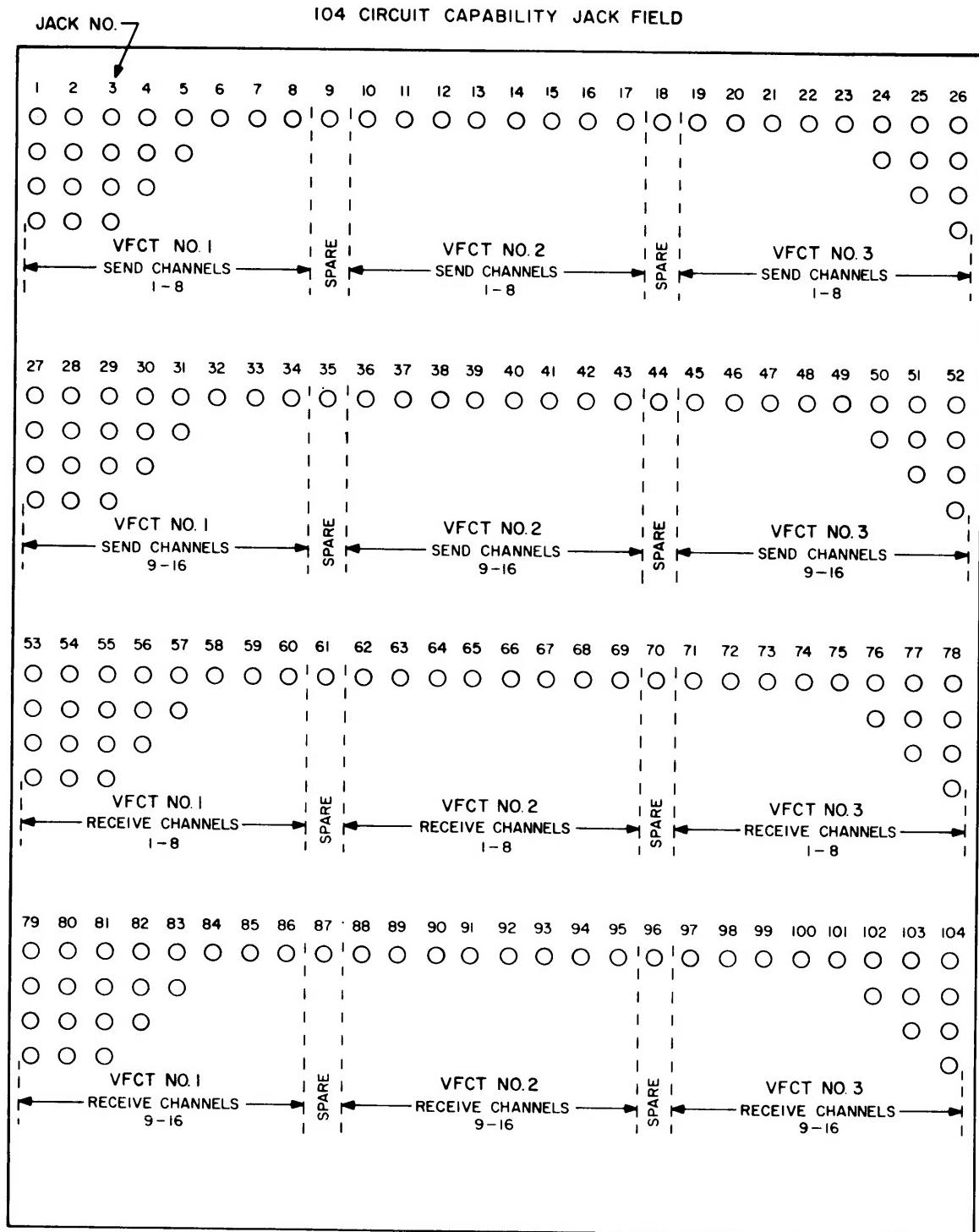


Figure 3-3. VFCT Jack Field Arrangement

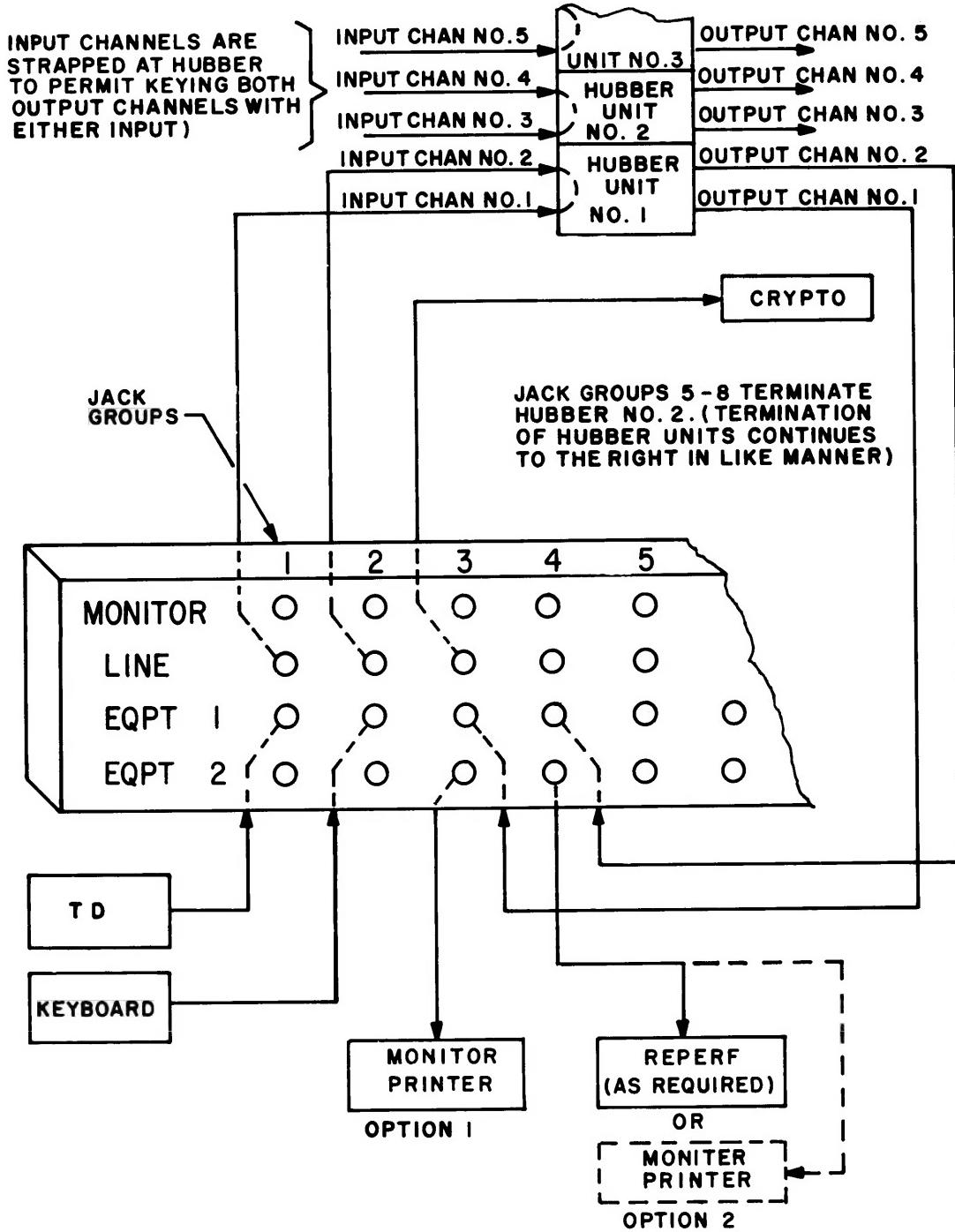


Figure 3-4. Hubber Unit Jack Field Arrangement

### 3.4.3 Audio Patchboards

The circuit layout of the audio-frequency patchboards is determined by their use. Where the patchboards are used to support intersite channels, the channels are grouped according to their receive or transmit function. Within a group, the channels will appear in consecutive order from left to right and top to bottom. For DCS Stations, the requirements of MIL-STD-188-310 will govern. For small stations, both the transmit and receive channels will appear in the same cabinet and the receive channels will be positioned below their corresponding send channels.

## 3.5 ORDERWIRE EQUIPMENT

Orderwire circuits are used for the coordination of the communications resources of the Naval Communication Station and for the coordination of the communication circuits between stations. The terminal location for orderwire circuits is the technical control facility (supervisory area). The terminal device, telephone or teletypewriter, may be shared among several orderwire circuits, provided that each circuit includes an alarm to indicate an incoming call. The need for a continuous log or record of the information transmitted and received on an orderwire circuit must be considered when planning the types and the number of terminal devices to be installed. However, voice orderwire capabilities are not normally provided with record facilities. Paragraph 5.4.2 of MIL-STD-188-310 governs the intercommunications requirements of DCS stations, and paragraph 5.4.4 governs the orderwire systems requirements.

## 3.6 COMMUNICATIONS SECURITY EQUIPMENT

The communications security (COMSEC) equipment performs cryptographic functions to convert between Red and Black data. COMSEC equipment is installed in the communications security equipment area of the communications center and is arranged in racks by types. Operator access is a major consideration in placing the equipment. Since the COMSEC devices alert operators to alarm conditions by visual and audible means, the equipments should be visible from the Red and Black patchboards that are located with the COMSEC equipment. Teletypewriter equipment must be collocated with the cryptographic devices to aid in restarting. One restart teletypewriter is usually provided for each group of 5 cryptographic equipments. Refer to figure 3-5.

## 3.7 TIME AND FREQUENCY STANDARD

A central time and frequency standard for the various equipments used throughout the communications center is being planned. Some existing systems generate 5-MHZ, 1-MHZ, and 100-kHz frequencies which are distributed to the equipments to control timing and to stabilize the frequency of modulation and demodulation equipment. However, the requirements for redundancy in the event of failure and for isolation of Red and Black data have not yet been fully defined for the time and frequency standard. When approved, the time and frequency standard will be installed in and operated as part of the technical control equipment. The output of the central time and frequency standard will be distributed through coaxial cables routed in the same trays with the signal cabling. Paragraph 5.4.9 of MIL-STD-188-310 sets forth the requirements for a Station Timing Standard System for the TCF of DCS Stations.

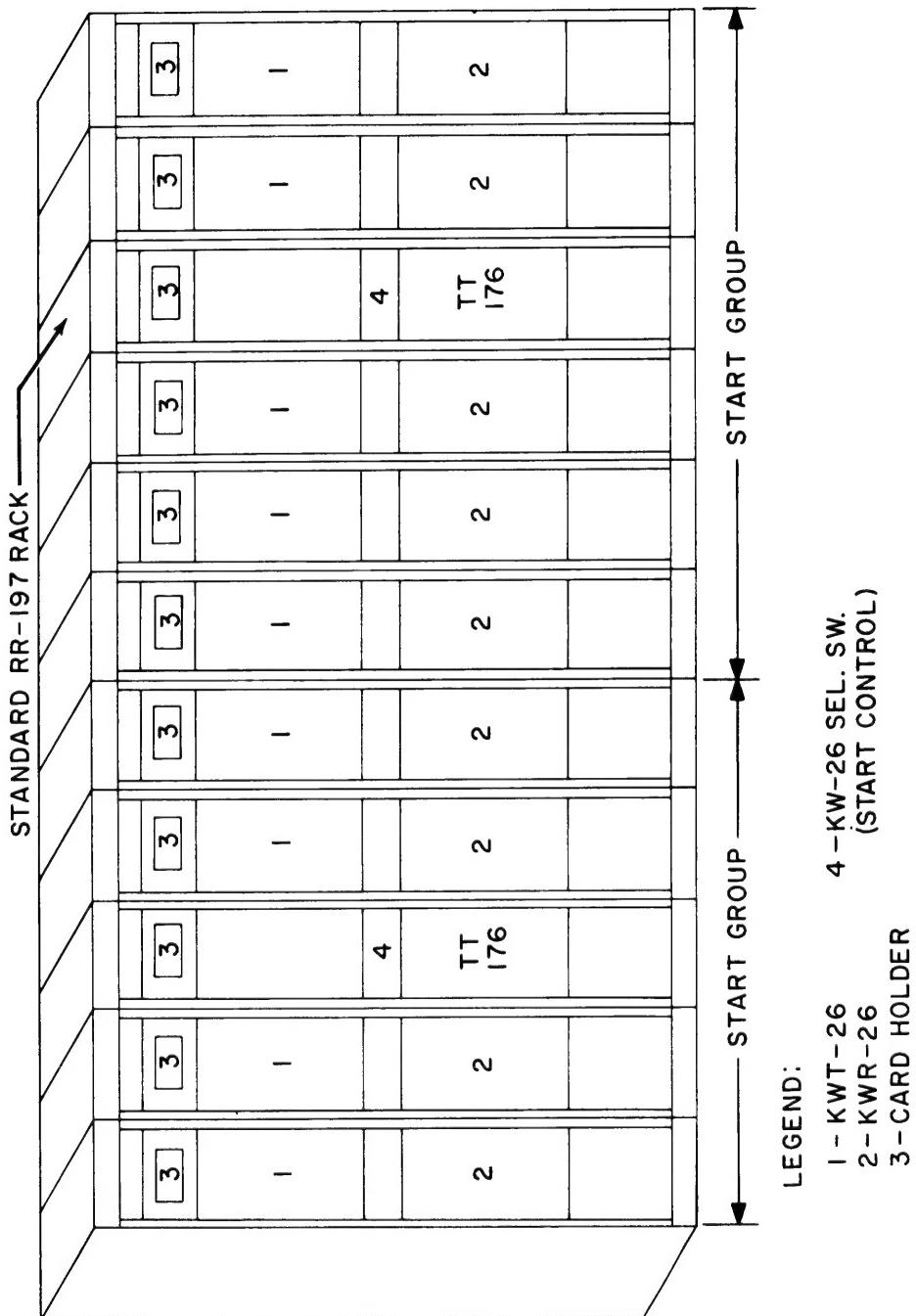


Figure 3-5. Typical Arrangement for Cryptographic and Restart Equipment

### 3.8 AUDIO FREQUENCY INTERFACE EQUIPMENT

Most information sent from or received at the communication center is in the form of analog signals carried in a 300- to 3400-Hz band. The audio-frequency equipment provides the interface between the communications center and all landline, line-of-sight, cable, or other transmission means. Such equipment provides the equalization, attenuation, amplification, or other signal conditioning that is needed for the interface between the transmission means and the equipments of the communication center. These equipments are contained within the patch and test (terminal equipment) area. Refer to chapter 6 for a discussion of the link equipment used for intersite communications.

### 3.9 VOICE FREQUENCY CARRIER TELEGRAPH EQUIPMENT

The VFCT terminal equipment combines up to 16 separate teletype and digital DC signals into complex tones for radio transmission using a 3-kHz bandwidth. The terminal also separates a received 3-kHz complex tone signal into its individual DC signals. VFCT is the primary means of transmission for large-volume, long-haul traffic in the Navy.

The VFCT channel assignment, center, mark, and space frequencies for Navy tactical circuits are to be in accordance with tables 3-1 through 3-3. These tables were promulgated by message ALCOM 79, 1968. The ALCOM also requires that all VFCT channels use negative polarity (inverted or reverse) sensing. The communications center may use VFCT equipment to interface with systems other than Navy tactical systems. In this case VFCT channelization and frequency assignment would be determined on a special case basis.

The capability of monitoring the quality of the composite and individual signals may be incorporated within the equipment. In any case the monitoring equipment used operates in parallel with the functioning circuit, measures the distortion content, and must be capable of operating at the 37.4 to 150 baud rate. When automated monitoring equipment is employed, the circuit status display is located within the TCF supervisory area.

### 3.10 DIGITAL-DATA END-INSTRUMENT EQUIPMENT

Data terminals consist of input and output equipments, modulation and demodulation devices, and manual or automatic supervisory controls. The digital signals are received from and sent to the equipment by one or more of the methods listed in table 3-4. A terminal may also perform temporary storage, code format, and band conversion functions. Conversion of data between serial and parallel form, when required, is also a function of the data terminal.

The ability of the transmission media to pass the required data rate is an important factor in planning communication Systems. Generally, the higher the required data rate, the broader the required bandwidth. Detailed technical guidance for determining the necessary bandwidths for the various modulation schemes and rates is contained in pertinent sections of appropriate MIL-STD-188-( ) series.

Table 3-1. VFCT Channelization

CHANNEL DESIGNATION	MARK FREQUENCY (Hz)	CENTER FREQUENCY (Hz)	SPACE FREQUENCY (Hz)
1	382.5	425	467.5
2	552.5	595	637.5
3	722.5	765	807.5
4	892.5	935	977.5
5	1062.5	1105	1147.5
6	1232.5	1275	1317.5
7	1402.5	1445	1487.5
8	1572.5	1615	1657.5
9	1742.5	1785	1827.5
10	1912.5	1955	1997.5
11	2082.5	2125	2167.5
12	2252.5	2295	2337.5
13	2422.5	2465	2507.5
14	2592.5	2635	2677.5
15	2762.5	2805	2847.5
16	2932.5	2975	3017.5

Table 3-2. VFCT Channelization Using Twinning (Quadruple Diversity)

TWINNED CHANNEL DESIGNATION	TWINNED CHANNEL CENTER FREQUENCY (Hz)	NORMAL CHANNEL CENTER FREQUENCY (Hz)
1 (9)	1785	425
2 (10)	1955	595
3 (11)	2125	765
4 (12)	2295	935
5 (13)	2465	1105
6 (14)	2635	1275
7 (15)	2805	1445
8 (16)	2975	1615

Table 3-3. Digital Data Input And Output Methods

INPUT	OUTPUT
Keyboard	Page printer
Punched paper tape	Punched paper tape
Magnetic tape	Magnetic tape
Direct computer input	Direct computer output
Punched card	Punched card

Distribution of digital data throughout the communications center is accomplished via DC circuits using low level polar signal loop voltage. The nominal low level voltage and current for a "mark" is  $+6 \pm 1.0$  volt, 0.001 ampere (max), and for a "space" is  $-6 \pm 1.0$  volt, 0.001 ampere (max). Low level keying is specified for use within the communications center for both Red and Black circuitry. Red circuits carry, or are cleared to carry, classified plain-text traffic. Black circuits carry traffic protected by communications security (COMSEC) equipment or unclassified, plain-text traffic. Black DC circuits are currently distributed using high level neutral or polar current loops; however, communications centers using high level loops are interim installations and will be converted to low level on a case basis. In a neutral circuit, the marking condition occurs when the signal loop is closed. The polar circuit reverses the current of the signal loop to differentiate between the marks and spaces. Positive voltage represents a mark and negative voltage a space. The current and voltage parameters for high level loops are listed in table 3-5. High level DC loops, usually neutral, will find continuing use at transmitting stations, and for communications over small tributaries on a special case basis. Therefore the advent of low level Black systems may not entirely eliminate high level lines that must interface with other Navy or public carrier lines. Western Union may use 130 volt 20-milliamper polar keying, while wire lines frequently use both a positive and a negative 130 volt battery for the two sides of the line, giving an effective voltage of 260 volts.

Table 3-4. Interim High-Level Signal Loop Parameters

	POLAR*	NEUTRAL*
Loop Current	20 mA $\pm 10\%$	60 mA or 20 mA $\pm 3\%$
Loop Voltage	$+60$ V $\pm 2\%$ , $-60$ V $\pm 2\%$	130 V $\pm 2\%$
Termination Impedance	150 ohms	150 ohms

\*Refer to pertinent section(s) of appropriate MIL-STD-188-( ) series for detailed information on voltage and current parameters of various telegraph systems that might be encountered in the United States and in other countries.

### 3.10.1 Automatic Digital Network (AUTODIN)

The AUTODIN digital subscriber terminal is installed within the communications center. Figure 3-6 shows the family of systems being supplied and their major components and capabilities. Standard Plans are issued to insure standardization of installation and arrangement. These plans show the permissible equipment arrangements from which the best one for the location is selected.

Figure 3-6. DSTE Set Capabilities and Concepts

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### 3.10.2 Teletypewriter Equipment

Teletypewriter equipment is used as record data and instruments and for circuit monitoring of data circuits. Nominal speed for the majority of teletypewriter circuits is 100 words per minute (WPM). Baud rates are normally 74.2 (for 7.42 unit character intervals) and 75.0 (for 7.00 unit character intervals). Teletypewriter access circuits to computers will normally operate at 150 baud under the present state-of-the-art.

Standard plans have been promulgated for the installation of most commonly used types of teletypewriter equipment, including low level installations.

### 3.11 AUTOMATIC SECURE VOICE COMMUNICATIONS

The Automatic Secure Voice Communications (AUTOSEVOCOM) System is a worldwide voice network that provides four wire secure and non-secure voice quality communications between designated military commands (subscribers). AUTOSEVOCOM interconnects locations with either narrow-band (NB) or wide-band (WB) communications channels. A narrow-band channel will support communications at a rate of 2400 bits and 9600 bits per second. The 2400 bits can be transmitted over a 3-kHz HF radio circuit. The wide-band circuit supports communications at 50 kilobits per second and is transmitted by wire, microwave or satellite means.

The Navy Communications Center supports the system by operating subscriber terminals that interface between the worldwide system and the local subscriber or an HF radio circuit (Steam Valve) which in turn connects with the subscriber. The subscriber is homed to the worldwide system either on a secure voice switch or directly on an Automatic Voice Network (AUTOVON) switch or to a Joint Overseas Switchboard (JOSS). The AUTOSEVOCOM equipment provides for WB secure voice communications between local subscribers and enables local subscribers to establish long distance voice calls with other military commands. The AUTOVON switch provides NB, long-haul communications for subscribers that cannot be economically served by WB equipment. The majority of long-distance calls are routed via the AUTOVON system. NB and WB circuit parameters for AUTOSEVOCOM are prescribed by the latest issue of DCAC 310-130-1 — "Processing of Telecommunications Service Requests."

Simplified typical single line circuit flow diagrams for the AUTOSEVOCOM system within the communications center are shown in figures 3-8 and 3-9. The minor relay AUTOSEVOCOM interface (figure 3-8) is the system used for HF secure voice to the fleet. Figures 3.8A depicts an AUTOSEVOCOM narrowband subscriber terminal used to provide single subscriber secure voice access when subscriber is not within a 15 mile radius of major relay facilities. Figure 3.8B depicts WB/NB facilities used when more than one subscriber is co-located. When a major relay with both NB and WB capabilities is required, a system similar to that shown in figure 3-9 is used. Typical floor plans for AUTOSEVOCOM systems are contained in the latest issue of DCAC 300-S175-10. Controlling criteria for the overall system are contained in the latest issues of the following publications:

DCAC 300-S175-10	NAVELEX Standard Plans
DCAC 310-S70-12	NAVELEX Std. Plan 0100309A
DCAC 310-130-1	NAVELEX Std. Plan 0100310A
DCAC 370-S185-9	NAVELEX Std. Plan 0100311
DCAC 370-S185-10	NAVELEX Std. Plan 0100314
MIL HDBK 232	NAVELEX Std. Plan 0100347
JANAP-138	NAVELEX Std. Plan 0100348
NC INST 02302.2A	NAVELEX Std. Plan 0100430

CHARACTERS LOWER CASE UPPER CASE COMM WEATHER	CODE SIGNALS							CCITT NO. 2 UPPER CASE*	PERFORATED TAPE
	START	I	2	3	4	5	STOP		
A - ↑									0 0 0
B ? ⊕									0 0 0 0
C :									0 0 0
D # ↗								WRU	0 0 0
E 3 3									0 0 0
F I →								UNASSIGNED	0 0 0
G 8 ↘								UNASSIGNED	0 0 0
H STOP ↓								UNASSIGNED	0 0 0
I 8 8									0 0 0
J ' ↙							.	AUDIBLE SIGNAL	0 0 0
K ( ←									0 0 0 0
L ) ↘									0 0 0
M .									0 0 0 0
N , ①									0 0 0 0
O 9 9									0 0 0
P 0 0									0 0 0 0
Q I I									0 0 0 0
R 4 4									0 0 0
S BELL BELL								' (APOSTROPHE)	0 0 0
T 5 5									0 0 0
U 7 7									0 0 0 0
V ; ①								=	0 0 0 0
W 2 2									0 0 0
X / /									0 0 0 0 0
Y 6 6									0 0 0 0
Z " +								+	0 0 0
BLANK -									0 0 0
SPACE									0 0
CAR. RET.									0 0
LINE FEED									0 0
FIGURES									0 0 0 0
LETTERS									0 0 0 0 0

NOTE: UPPER CASE H (COMM) MAY BE STOP OR FF

WORDS PER MINUTE	UNIT CODE	SIGNAL LENGTHS IN MILLISECONDS STANDARD SPEED								TOTAL MILLISECONDS PER CHARACTER	OPERATIONS PER MINUTE
40	7.42	33	33	33	33	33	33	47	245	240	
57	7.96	22	22	22	22	22	22	43	175	342 ①	
60	7.42	22	22	22	22	22	22	31	163	368	
62.5	7.27	22	22	22	22	22	22	28	160	375 ②	
65	7.00	22	22	22	22	22	22	22	154	390 ③	
66.7	7.50	20	20	20	20	20	20	30	150	400 ④	
67.3	7.42	20	20	20	20	20	20	28.4	148.4	404 ⑤	
75	7.42	18	18	18	18	18	18	25	133	460	
100	7.42	13.5	13.5	13.5	13.5	13.5	13.5	19	100	600	
106	7.00	13.5	13.5	13.5	13.5	13.5	13.5	13.5	94	636	



MARKING PULSE



SPACING PULSE

\* THIS COLUMN SHOWS  
ONLY THOSE CHARACTERS  
WHICH DIFFER FROM THE  
AMERICAN VERSION.

① USED WITH CRYPTO

② USED WITH CRYPTO AND AN/FGC-5

③ USED WITH WESTERN UNION CIRCUITS

④ USED WITH BRITISH GPO TELEGRAPH

⑤ AMERICAN EQUIVALENT OF EUROPEON STANDARD.

Figure 3-7. Characteristics Associated with the Teletypewriter Code

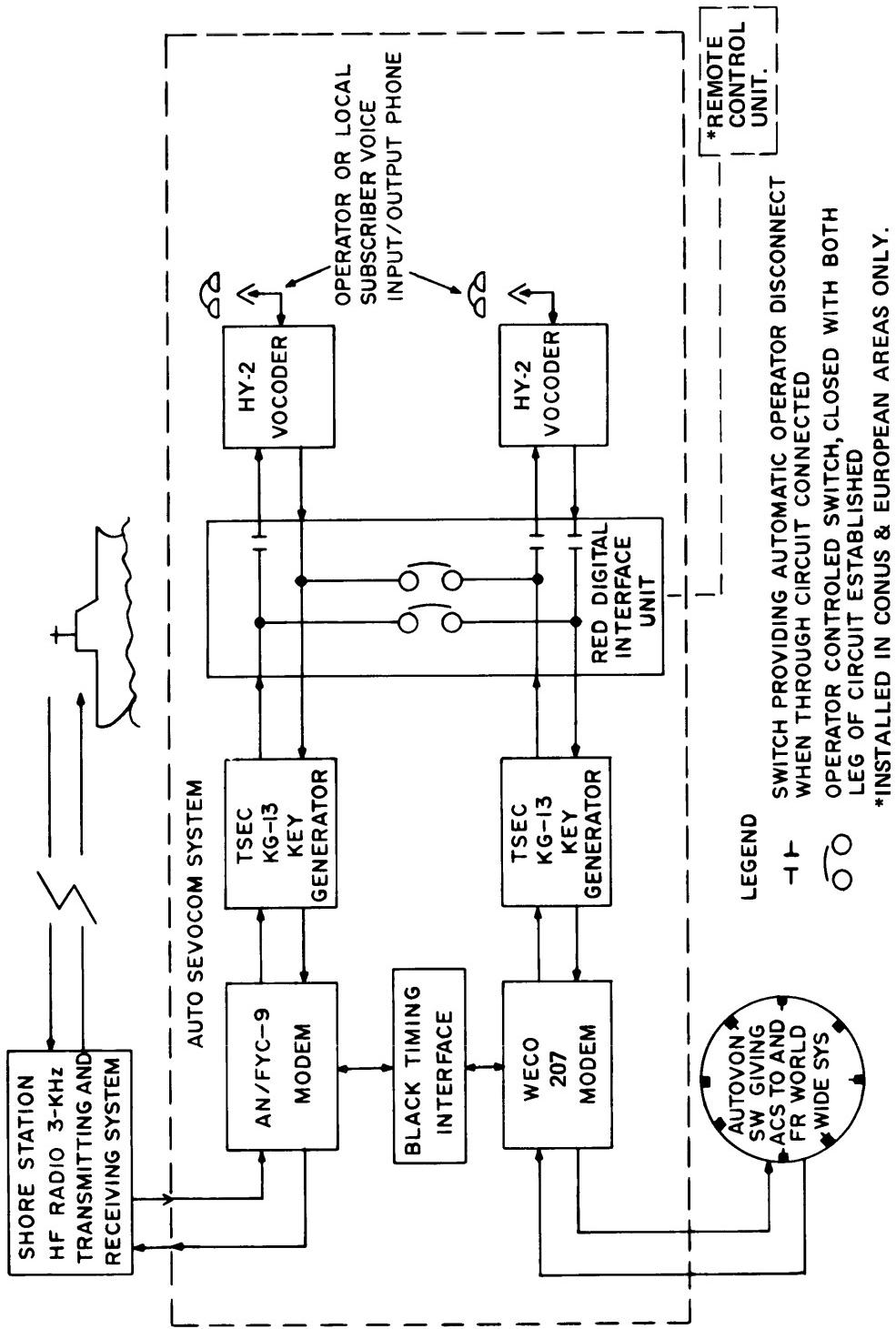


Figure 3-8. Minor Relay AUTOSEVOCOM Narrow-Band Interface

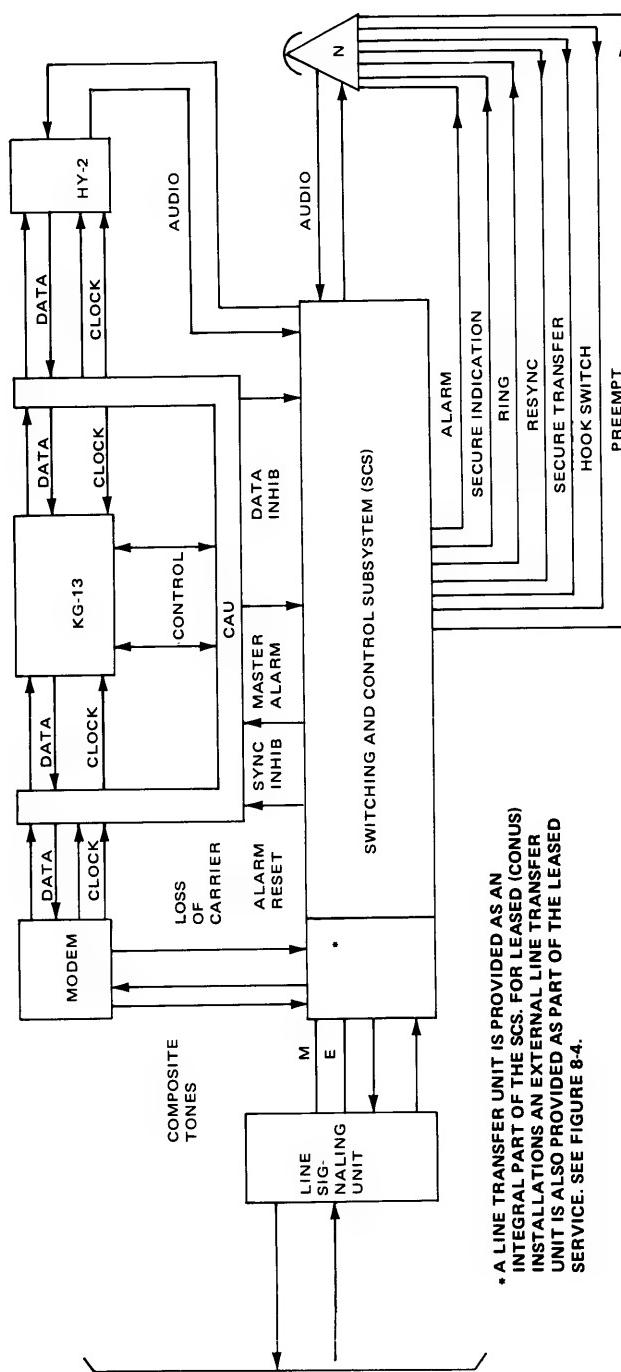


Figure 3. 8A. Government-owned Narrowband Subscriber Arrangement  
Combined Red-Black Telephone

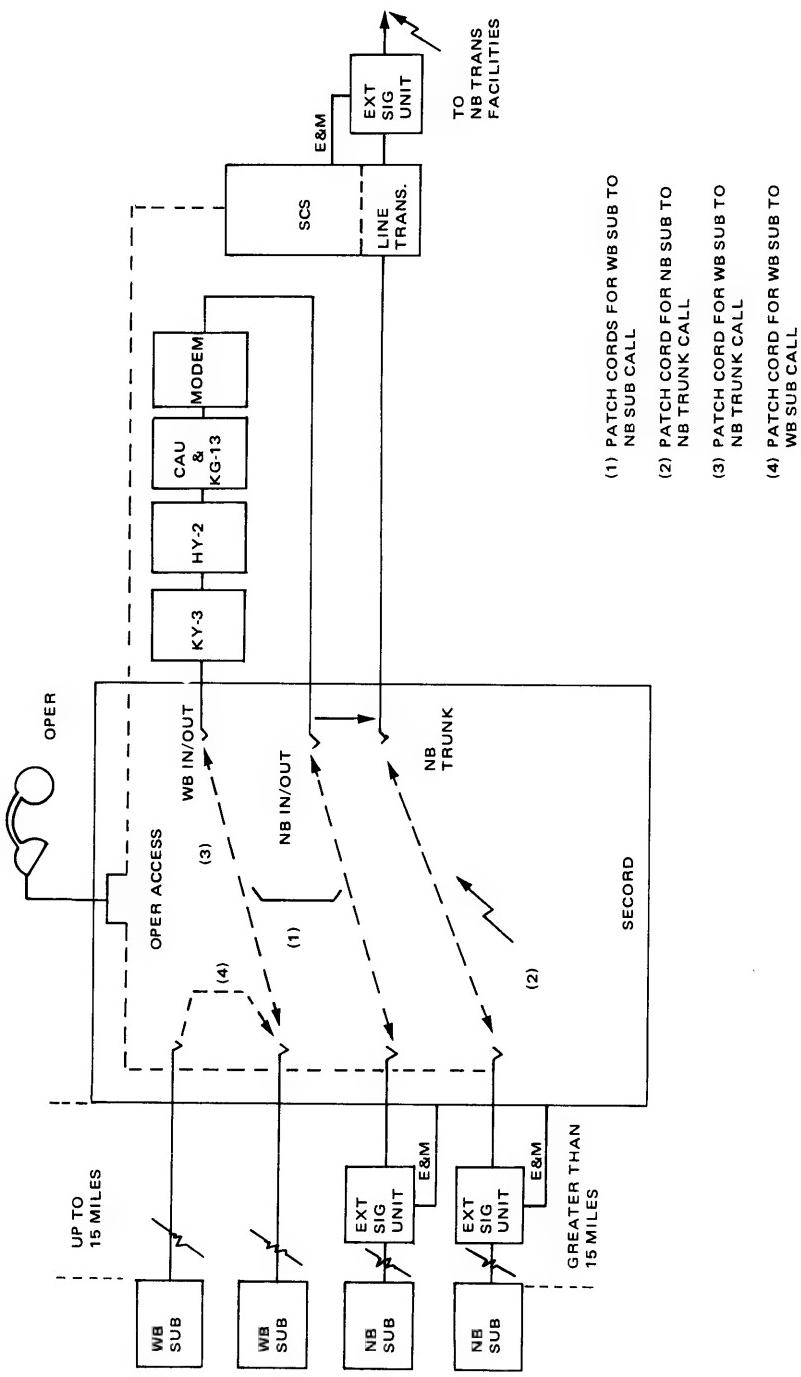


Figure 3.8B. SECORD and REQUIRED ADDITIONAL EQUIPMENT

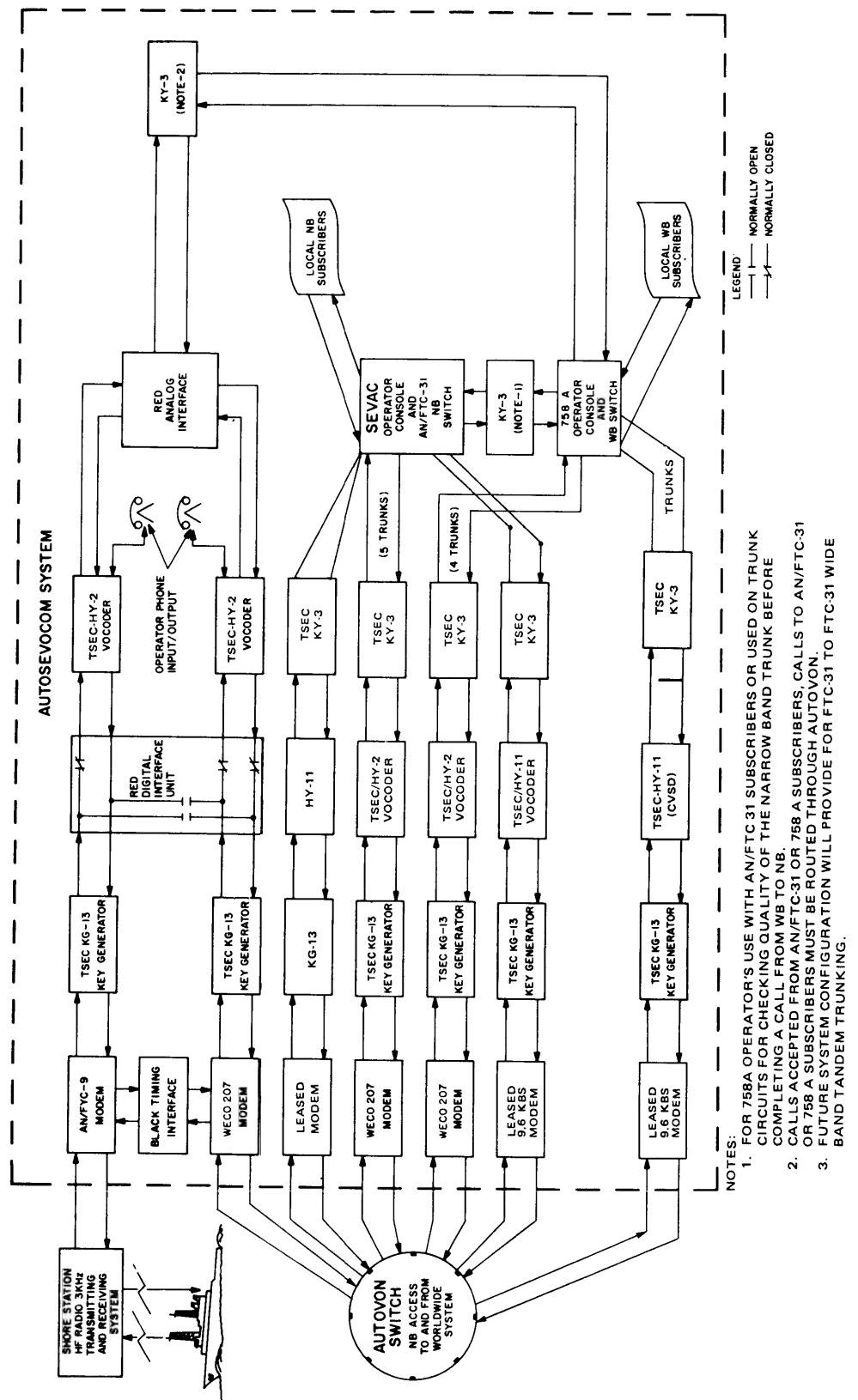


Figure 3-9. Typical AUTOSEVOCOM Interface

### 3.12 CABLING AND DISTRIBUTION FRAMES

The controlling criterion for the planning and installation of cabling and distribution frames in the communications center is the separation of circuits carrying Red information from those carrying Black information. Refer to the latest issue of NAVELEX Instruction 011120.1 — "Shore Electronics Engineering Installation Guidance for Equipments and Systems Processing Classified Information." MIL-HDBK-232.

#### 3.12.1 Distribution Frames

Distribution frames are used to terminate cabling from equipments, patchboards, and battery sources. A distribution frame is also used to serve as a central point for the exit and entrance of all communications circuits concerned with the mission of the communications center. The general types of frames and their wiring criteria are discussed in chapter 9. As a general rule distribution frames are located near the patchboards they terminate to minimize the length of cable runs.

#### 3.12.2 Cabling

Cabling within the Communications Center is to be routed between equipments in a manner that presents a neat appearance and is compatible with the operational use of the system.

Conduit and duct systems have been used in the past. These were necessary due to high level signalling modes. Figure 3-10 shows an example of high level Red cable conduit/ducting. Such conduit is not required for low level circuits that are contained within a secure area. Low level circuits require at least an overall shield, but can be run in open cable basket-type ducting or cable trays within a secure area. MIL-C-28781 (EC), or MIL -C-23437 Military Specification, Cable, Electrical, Special Purpose, Shore Use will be the technical specification for communication center cabling. Refer to MIL-HB-232 and the appropriate equipment standard plan for cabling installation criteria details. Installation criteria for computer systems is contained in NAVELEX 0101, 111.

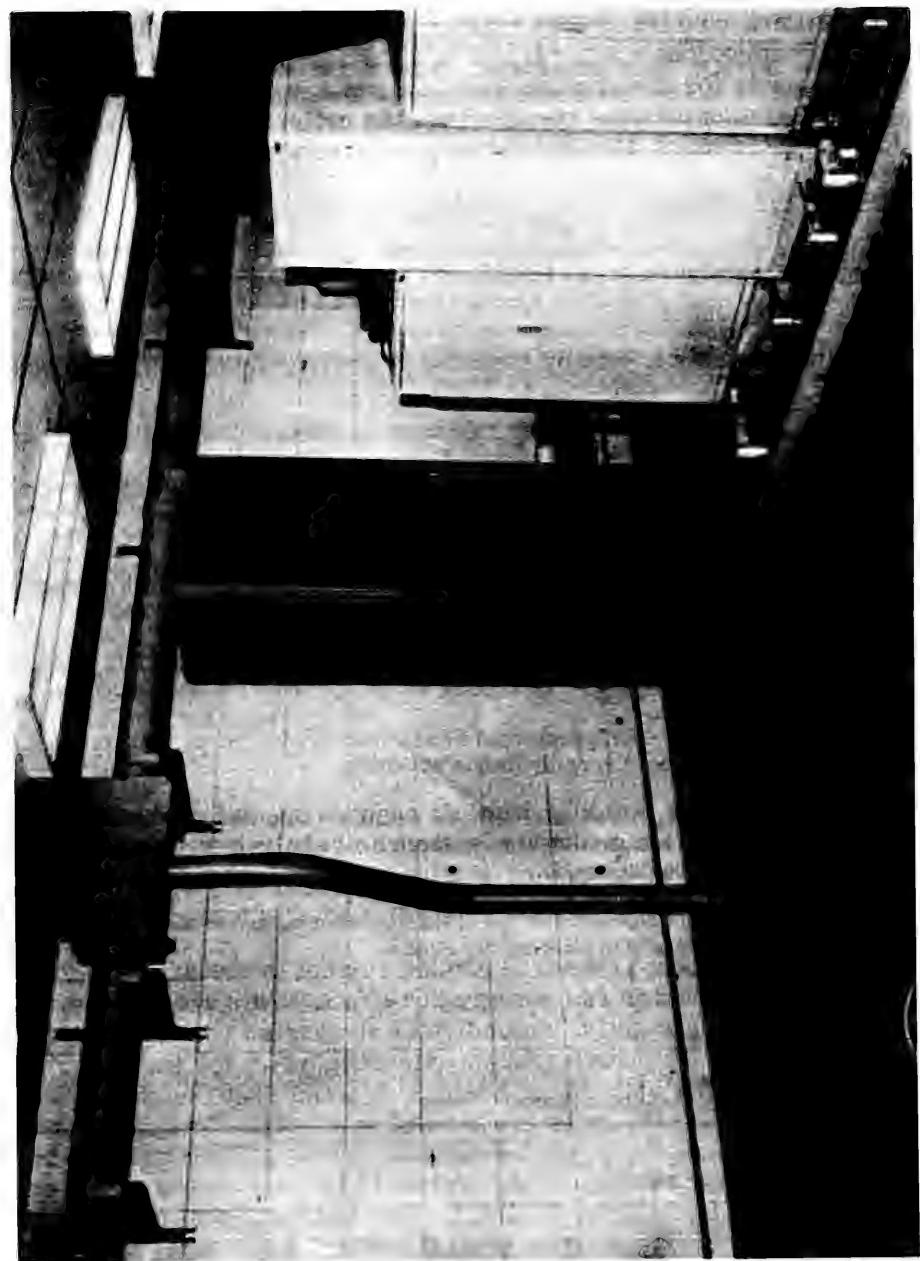


Figure 3-10. Typical Installation, Overhead Ducting

### 3.13 CONSTRUCTION AND INSTALLATION

Permanent communications center buildings are constructed of masonry and concrete and may consist of more than one floor. Semi-permanent construction (transportable) has been used also, and such stations are discussed in Chapter 13. The primary consideration in building construction is maximum operational efficiency. An example of a typical communications center layout is shown in figure 3-11 and the general building requirements for communications stations are discussed in Chapter 7. The following subparagraphs provide specific building criteria for the communications center building. (For more detailed building requirements, refer to NAVFAC DM-23, current issue).

#### 3.13.1 Building Features

- a. Cable vaults are not normally included in communications center buildings.
- b. A separate room is required for microwave system battery power supplies.
- c. A shielded maintenance shop is not normally required. Shielded rooms are provided only on a special case basis.
- d. Physical security requirements applicable to building construction are stated in the latest NAVELEX INSTRUCTION 011120.1.
- e. Criteria for Computer Systems is contained in NAVELEX 0101, 111.

#### 3.13.2 Grounding

The communications center building does not require special grounding or bonding for its structural members. One grounding system is required for personnel and equipment protection and a second grounding system is required to ground the signal circuits.

The personnel and equipment protective ground system is the AC protective ground distribution, described in chapter 12, paragraph 12.6.1. This ground distribution is basically the green wire protective ground which is carried to each equipment along with the power feeders. The earth ground connection point for the AC ground distribution system must comply with the provisions of article 250-84 of the National Electrical Code and therefore, must not present more than 25 ohms to ground.

The governing criteria for the grounding system to be used as the signal ground are contained in NAVELEX Instruction 011120.1. The following general requirements must be met when engineering a signal ground system.

- a. The signal ground system may have its own ground connection point. NAVELEX Instruction 011120.1 specifies the type of ground connection to be used for both large and small systems.
- b. Separate ground distribution systems are required for Red and Black signal grounds. NAVELEX Instruction 011120.1 specifies when and where these two systems are to be interconnected.

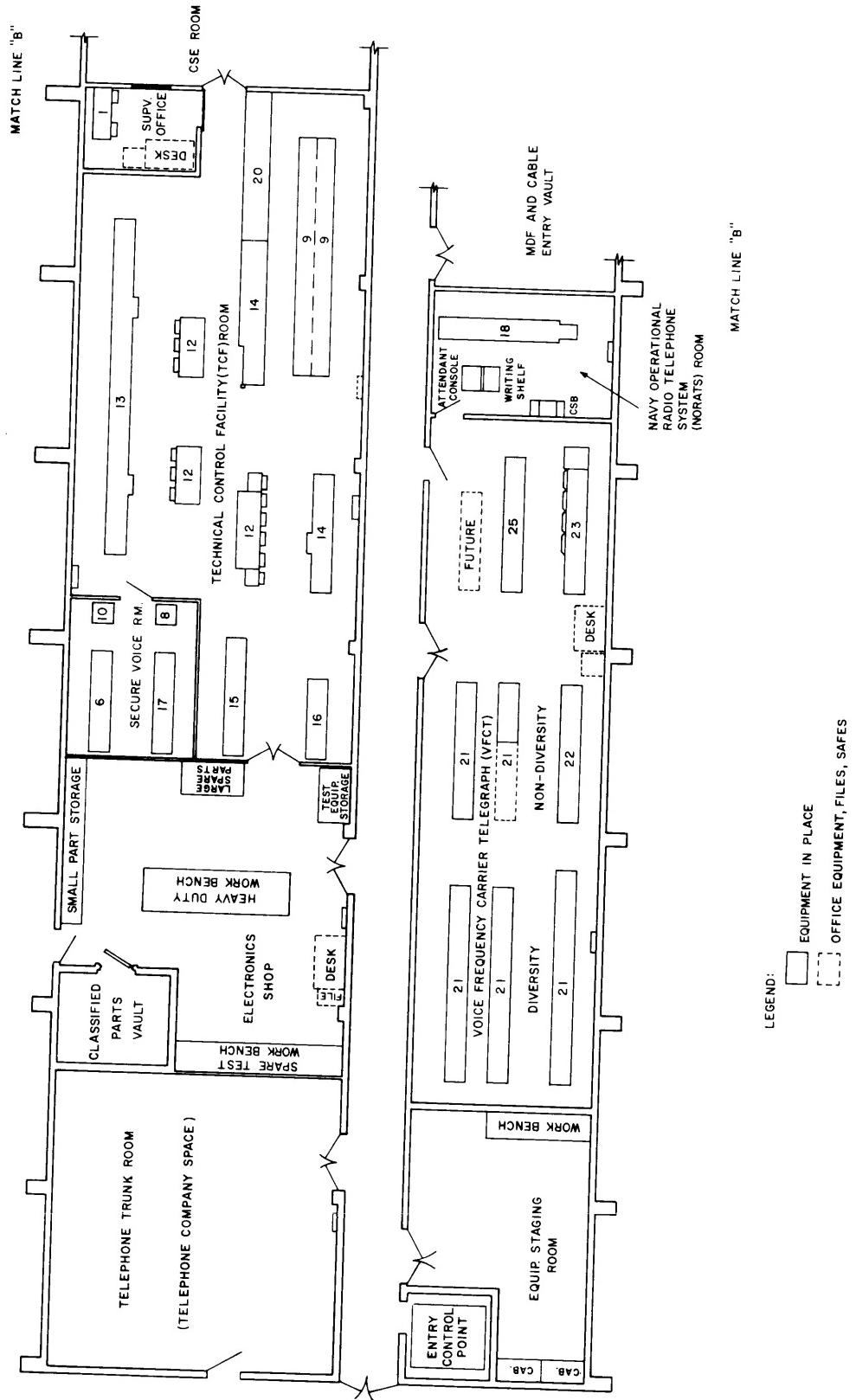


Figure 3-11. Typical Communications Center Layout (Sheet 1 of 3)

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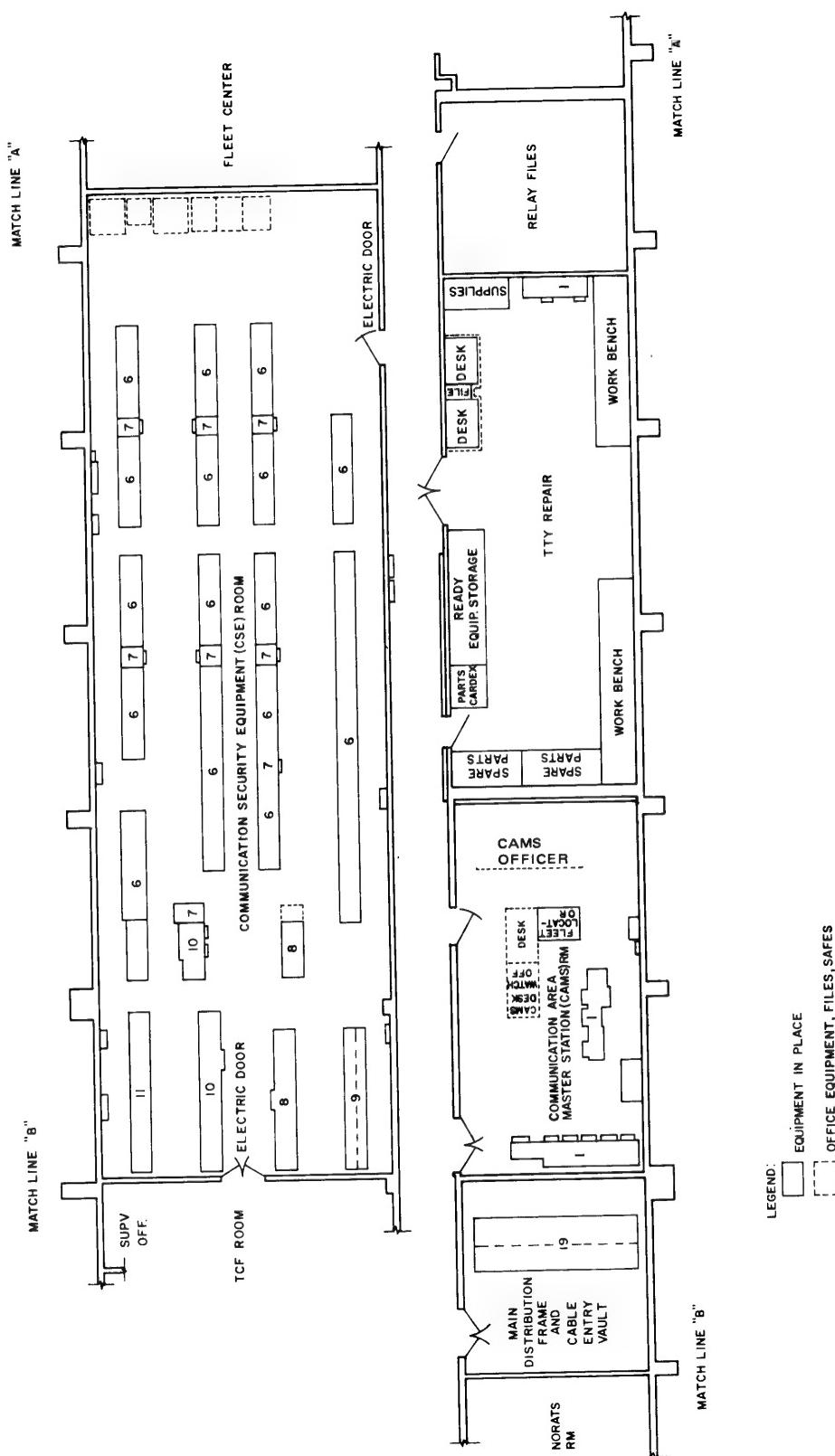


Figure 3-11. Typical Communications Center Layout (Sheet 2 of 3)

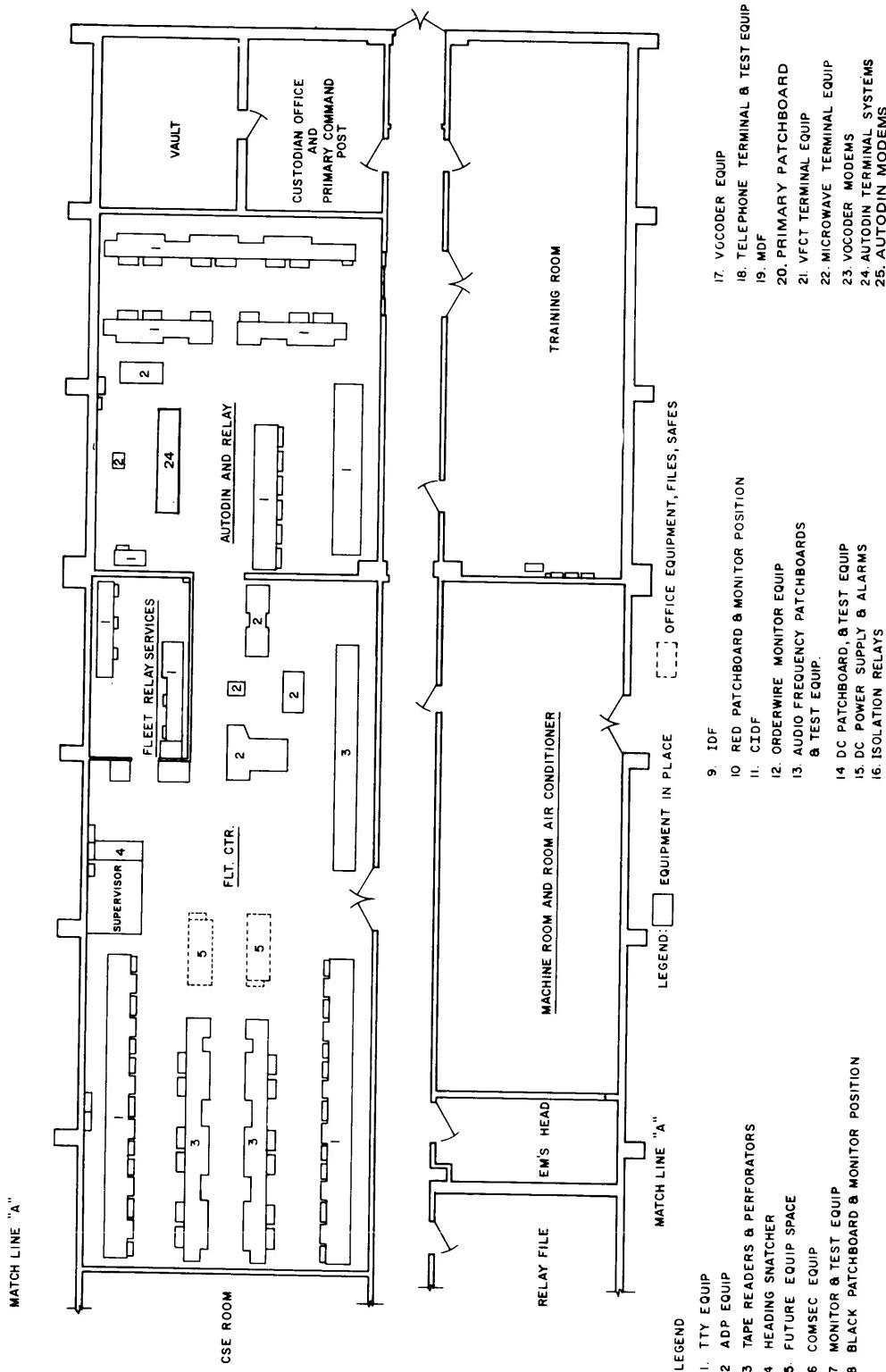


Figure 3-11. Typical Communications Center Layout (Sheet 3 of 3)

### 3.13.3 Building Electrical Power

The primary power for the communications center is usually supplied by a commercial power company. An emergency power source may be provided to satisfy operational reliability requirements. The electrical power requirement for additional capabilities or for a new facility is stated in the BESEP for the use of the Naval Facilities Engineering Command (NAVFAC) Engineering Field Division (EFD). The following factors are applicable to the communications center power system:

- a. No-break power (Class D) is provided for designated equipments. These equipments usually include the synchronous communications security equipments.
- b. All communications equipment not connected to no-break power will be fed from the technical load bus.
- c. The technical load bus may be subdivided into a critical technical load and a noncritical technical load. This will permit orderly restoration of power in the event of failure and will make load shedding possible in the event of power shortages.
- d. Separate circuit breakers are required at the power distribution panel for each equipment rack or cabinet.

### 3.13.4 Equipment Arrangement

Efficiency is the primary consideration for locating equipment in the operations area. The general rule is that equipments used to perform the same or similar function are grouped together. The floor space to be provided for equipment access is governed by tables 3-5, 3-6, and 3-7. The criteria presented in these tables were developed through application of the provisions of MIL-STD-1472 - Human Engineering Design Criteria for Military Systems, Equipments and Facilities. The following guidance is provided for using tables 3-5, 3-6, and 3-7:

1. To determine the minimum distance relationship between front faces of two dissimilar lines of equipment, enter table 3-5 at the first equipment. Pass down the "arrow" line to the second equipment line. The distance in feet is then read directly.
2. To determine the minimum distance between front faces of two similar lines of equipment, enter table 3-5 at the type equipment line. Proceed down the "arrow" line to the unit line and read distance in feet directly.
3. To determine the minimum distance from the front face of an operating equipment line to a non-operating obstruction (bulkhead, back to another equipment line, etc.) enter table 3-6 at the desired equipment line. Pass down the "arrow" line to the unit line and read the distance in feet directly.
4. To determine the minimum distance between rear faces of two dissimilar lines of equipments, enter table 3-7 at one of the equipment lines. Pass down the "arrow" line to the second equipment line and read the minimum distance in feet directly.
5. To determine the minimum distance between rear faces of two similar lines of equipment, enter table 3-7 at the equipment line. Pass down the "arrow" line to the unit line and read the distance in feet directly.

6. It should be noted that rear distances are maintained after initial installation. Further, these tables do not address adjacency access requirements of equipments; the tables consider only the front and rear access to the equipment lines. In cases not covered by these tables, the following guidance is provided:

- a. Minimum front clearance for operating single line of equipments shall be four feet.
- b. Minimum front face to front face clearance for two lines of similar operating equipments shall be the minimum for a single line increased by a factor of 1.6, e.g., 4 feet X 1.6 = 6.4 feet for a double line.
- c. The minimum rear access for equipments is determined by the width of the doors or access panels when extended perpendicular to the rear face but in no case shall the rear clearance for equipments requiring rear access be less than 18 inches.

### 3.13.5 Siting

The communications center building is physically separated from other station buildings such as power generating plants and living quarters. Also, to reduce to a minimum the possibility of mutual interference, the communications center is separated from other portions of the communications station as shown in table 3-8 and 5-3.

**Table 3-5**  
**Equipment Access Space Requirement**  
**Front Face-To-Front Face**  
**(Minimum)**

**Unit Line** is two similar lines of equipments operated face to face.

Front face is side of equipment at which operator works.

Table 3-6 Equipment Access Space Requirement		Front Face- To-Non-Operating Obstruction									
		Single Line Operating Space based on Operator Position									
		Unit Line is minimum distance to non-operating obstruction.									
DC PATCH BOARD LINE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
AF PATCH BOARD LINE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
ORDER WIRE LINE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
TTY PACKAGE EQUIPMENT	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
CRYPTO LINE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FGC-73 CONSOLE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FGC-73 REMOTE READER	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FGC-73 BRPE	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
TERMINAL EQUIPMENT	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
MANUAL PROCESS DESK	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
OUTSIDE BULKHEAD	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
THOROFARE DOOR	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
SINGLE TTY	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
THRU PASSAGEWAY	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
FAX MACHINES	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
COMPOUND TERMINALS (DIN)	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
OFFLINE PACKAGE —	(Refer to applicable CNO Itr(s) and NAVELEX Standard Plans for type equipment involved)										
TEST BAY	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
RCVR EQUIPMENT BAY	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
UNIT LINE	4	4	4	4	3	4	4	3	3	-	3

**Table 3-7**  
Equipment Access Space Requirement  
**Back Face-To-Back Face**  
**(Minimum)**

Unit Line is two similar lines of equipment and is also the minimum back access clearance for cabinets.

Table 3-7 Equipment Access Space Requirements		Back Face- To-Back Face (Minimum)									
DC PATCH BOARD LINE	2	Unit Line is two similar lines and is also the minimum back clearance for cabinets.									
AF PATCH BOARD LINE	2										
ORDER WIRE LINE	2										
TTY PACKAGE EQUIPMENT	2										
CRYPTO LINE	2										
FGGC-73 CONSOLE	2										
FGGC-73 REMOTE READER	2										
FGGC-73 BRPE	2										
TERMINAL EQUIPMENT	2										
MANUAL PROCESS DESK	2										
OUTSIDE BULKHEAD	2										
THOROFARE DOOR	2										
SINGLE TTY	2										
THRU PASSAGEWAY	3										
FAX MACHINES	2										
COMPOUND TERMINALS (DIN)	3										
OFFLINE PACKAGE		(Refer to applicable CNO Itrs(s) and NAVFELX Standard Plans for type)									
TEST BAY	2	2	2	2	2	2	2	2	2	2	3
RCVR EQUIPMENT BAY	2	2	2	2	2	2	2	2	2	2	3
UNIT LINE	2	1.5	2	2	0	0	2	0	-	-	1.5

Table 3-8. Communications Center Siting Separations

FACILITY	SOURCE OF INTERFERENCE	MINIMUM DISTANCE
Communications Center	VLF transmitters	5 mi
	Radar installation	1500 ft

